Beyond Canisters (SUMMAs): Passive and Active Samplers and International Perspective

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TO-17/PDS Tube

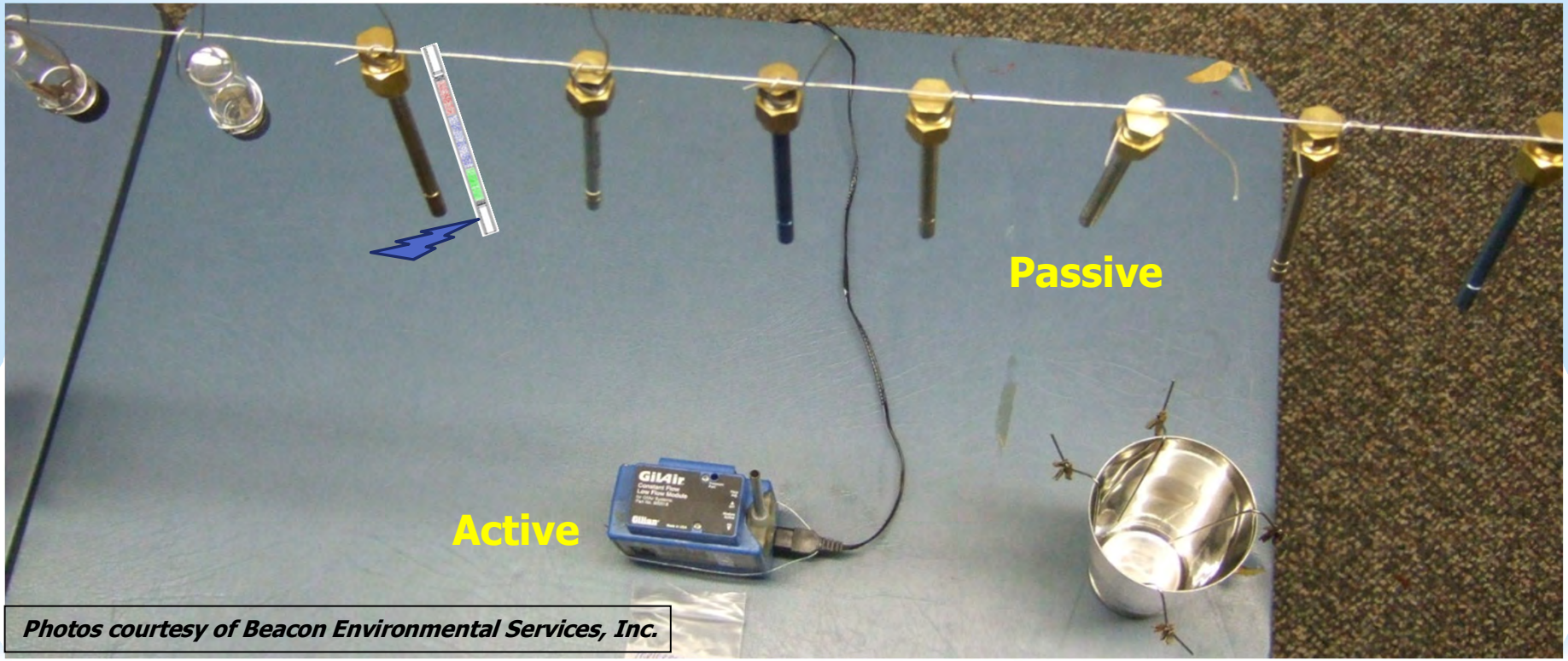
Length: Four inches (10. cm)

Diameter: ¼ Inch (6.3 mm)

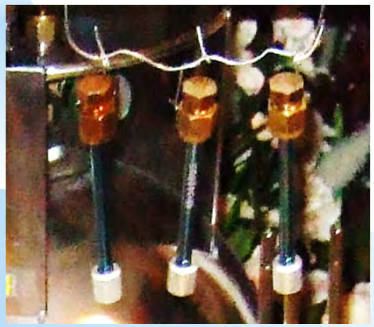
Weight: 1.8 ounces (45 g)

Passive and Active Applications

Passive Diffusion Devices and TO-17 Active Arrangement



Photos courtesy of Beacon Environmental Services, Inc.



Six-Liter Summa Canister

Height: One Foot plus (31 cm)

Diameter: ¾ Foot (22.9 cm)

Weight: Six Pounds (2.7 kg)

Advantages of Sorbent Tubes

- Convenient, small, portable and low cost
- Reusable at least 100 times
- Tubes are completely clean after thermal desorption and can immediately be reused for the collection of more samples.
- Suitable for a wide range of polar and nonpolar analytes
- Well validated with respect to storage stability – Up to 30 days for multi-sorbent tubes, 1-2 years for stable compounds on single sorbent tubes
- Suitable for a wide volatility range (C3 to C30 or C40 with quartz wool/beads)
- Well validated for occupational hygiene as well as ambient outdoor and indoor applications - low ppt to high ppm
- Large air volumes may be collected and analyzed facilitating better detection limits
- Suitable for both pumped and diffusive sampling (hours to weeks)

Limitations of Sorbent Tubes

- Not suitable for ultravolatile species such as acetylene
- Limited number of experienced laboratories in US, but growing
- Additional uptake rate studies needed for long-term exposure for diffusive samplers

Sources: Markes International Ltd. and Beacon Environmental Services, Inc.

Advantages of Canisters

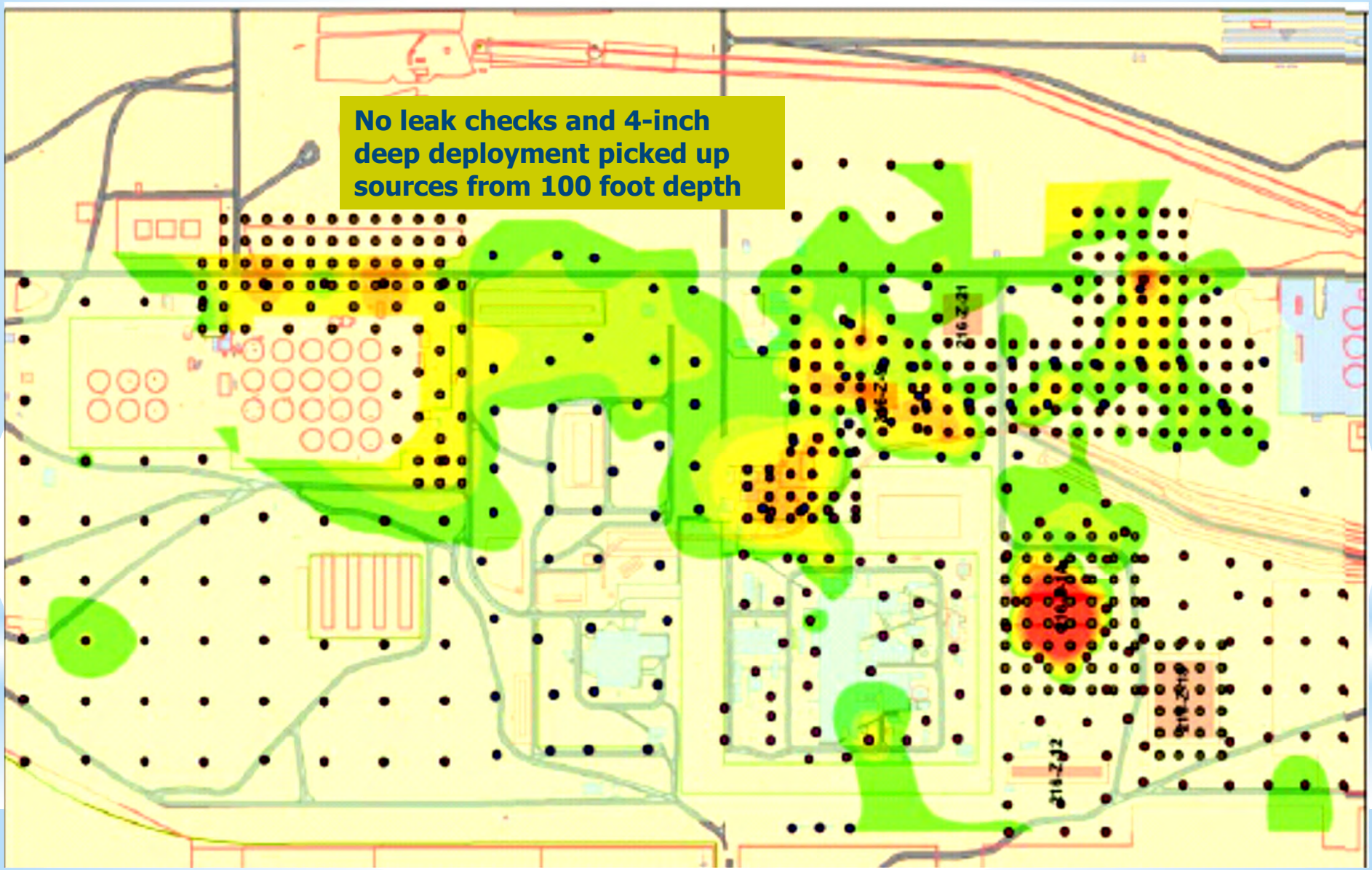
- Quantitative retention of very volatile organics
- Well validated for volatile nonpolar analytes for example US EPA TO-14/TO-15 target analytes and C_2 to n-C_{10} ozone precursors
- Easy collection of grab-samples into evacuated canisters

Limitations of Canisters

- Restricted analyte range - not suitable for polar compounds or VOCs with volatility >C10.
- Difficult and expensive to clean-Up to 100 cleaning cycles may be necessary. An effective and more efficient approach, however, is to put the contaminated canisters through 3 cleaning cycles, allow the canisters to sit for a couple of days, then repeat cleaning through three cycles, and check for cleanliness. Repeat this clean, store, and clean sequence as many times as necessary.
- Bulky - require special storage facilities and transport
- Partitioning effects with liquid water (*i.e.*, condensation inside the canister) can cause quantitation difficulties
- Sensitivity limited by the volume of air that can be sampled in the canister and the sampling period
- Not well suited for Time-Weighted Average monitoring over 24-hour periods.

Sources: Markes International Ltd. and Beacon Environmental Services, Inc.

Rapid Spatial Variability Assessment Using Sorbents



Carbon Tetrachloride Soil Gas Plume at the Plutonium Finishing Plant at Hanford: Waste Management Con. March 2010

Sorbent Sampling Guidance

EPA TO-17

Determination of VOCs in Ambient Air Using Active Sampling Onto Sorbent Tubes

ASTM D6196-09

Standard Practice for Selection of Sorbents, Sampling, and Thermal Desorption Analysis Procedures for Volatile Organic Compounds in Air

ASTM D4597-03 (2009)

Standard Practice for Sampling Workplace Atmospheres to Collect Gases or Vapors with Solid Sorbent Diffusive Samplers

ISO 16017-2

Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 2: Diffusive sampling

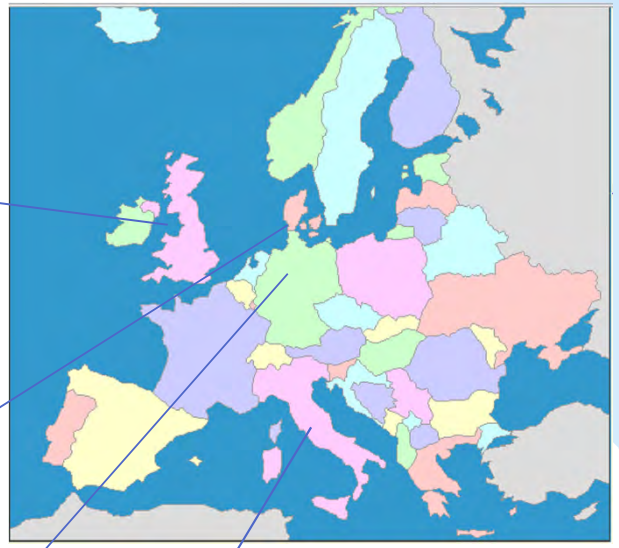
UK Health and Safety Executive MDHS-80

VOCs in Air: Laboratory methods using diffusive solid sorbent tubes, thermal desorption and gas chromatography

International Perspective

UK

Several hundred Thermal Desorption (TD) laboratories and, 5-6 use cans but only for ultra volatile, low concentration background pollution studies. Source: Markes



DENMARK

Extensive monitoring program for indoor air testing using sorbent technology implemented for homes with potential for vapor intrusion. Source: Majbrith Langeland, Grontmij Carl Bro

GERMANY

Approximately 170 TD laboratories and Zero labs using canisters for air analysis. Source: Markes and Perkin Elmer

ITALY

Approximately 200 TD laboratories of which 12 labs using canisters for air analysis. Source: Markes and Perkin Elmer

AUSTRALIA

10's of TD laboratories of which approximately half use canisters. Source: Markes International

Uptake Rate, Geometry and Sampler Design Govern Performance

Type	Average Uptake Rate cm3/min	Standard Deviation cm3/min	Coefficient of Variation
PC	0.237	0.008	0.036
PT	0.148	0.044	0.300
BA	0.149	0.011	0.074
PR	2.024	0.543	0.268

PC- Single Sorbent Tube

PT- Two Sorbent Tube

BA- Axial Two Sorbent Side By Side

BR- Radial Two Sorbent Side By Side

A controlled release of TCE in an indoor air environment allowed for over two orders of magnitude daily concentration variability over the course of the two-week monitoring event. [200 ug/m3 TCE max]

Minimize starvation effects by reducing uptake rate and ensuring minimum air velocity is maintained.

Table courtesy of Beacon Environmental Services, Inc.

Things to Consider

- High flow volumes across sorbent tubes/media. Greater than 100-1000L depending on the compound is limiting.
- Uptake Rates for all Passive Devices-Linear/Non-Linear Effects, Temperature, Humidity and Competitive Effects
- Passive Devices in High Concentration Subsurface Environments
- The use of sorbent technology across the world far exceeds the use of canisters.
- The depletion/starvation depends on two things, uptake rate of the compound as it relates to sampler configuration plus sorbent selection and the airflow. A radial sampler will have a higher uptake rate than an axial sampler thereby depleting the atmosphere more quickly. By limiting the uptake rate, the starvation effect may be avoided.
- Possible use of hyperactive sorbents for measuring transients at the second to minute scales

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